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through 22 November 1994

CONTRACT TITLE AND NUMBER:

InP Solar Cell Development on Inexpensive Si Substrates
Contract Number N00014-94-C-2030

CONTRACTING AGENCY:

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Contract Period: 22 February 1994 to 22 February 1995

STATUS:

Task 1 - Optimize Emitter/Base Dopants - At this point in the program, emitter designs have been roughly optimized for both P/N and N/P cells.

For P/N cells, the emitter formation and cell junction depth are determined by zinc diffusion from the InGaAs contact cap. Zinc is a P-type dopant in InP. When we attempted to define epitaxially grown emitters, these emitters, which had thickness on the order of 1000Å, were dominated by zinc diffusing out of the InGaAs contact cap, which effectively set the emitter depth at about 3000Å. It therefore made little difference whether the epitaxially grown emitter layer was 100 or 1000Å, since the junction depth was fixed by the zinc diffusing out of the InGaAs to 3000Å. Spire was able to improve the P/N cell performance by controlling the thickness of the InGaAs cap layer, the solid state diffusion source for the zinc, as well as the growth temperature (Figure 1). Best cell performance was with a 1000Å InGaAs cap thickness with the entire cell grown at 650°C. The cap thickness and growth temperature control the temperature-duration curve for the zinc diffusion.

For the N/P cells, a ~400Å grown Se-doped N-type emitter is used. The Se dopant does not diffuse significantly, so that in the N/P cell the grown emitter layer thickness determines the cell junction depth.

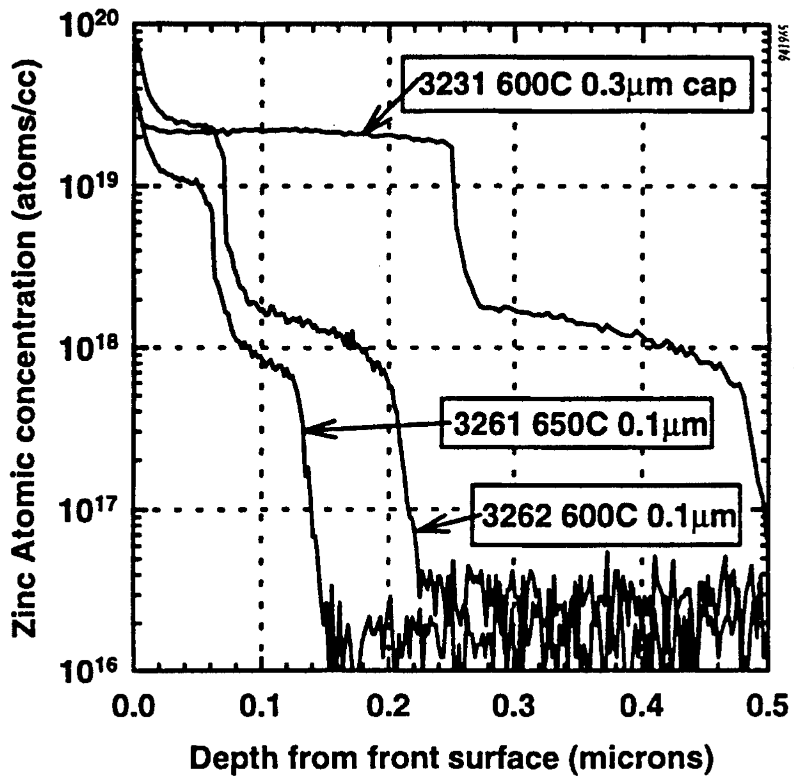

Figure 1 *Zinc diffusion into InP cell is controlled by InGaAs cap thickness and growth temperature. The zinc diffusion profile determines the junction depth of the cell at the point where it crosses 10^{17} cm^{-3}, which is the background N-dopant level.*

Task 2 - Optimize Cell - Cell masks, discussed in the last report, expected for 2 cm by 4 cm cells were received as expected. This task is almost complete for both P/N and N/P cells.

Task 3 - Produce Quantities of Small Optimized N/P and P/N Cells - These wafers were grown, processed, and delivered. This task is complete.

Task 4 - Optimize the InGaP Grading Layer - In the Phase II effort, we have twice attempted to use InGaP grading layers to lower dislocations and boost cell performance. Each time, while the results were not bad, no gain was seen over structures with simpler buffer layers. These experiments are described in the fourth quarterly report, which is being sent simultaneously with this third report.

Task 5 - Si Substrate Thickness - This task still needs to be completed.

Task 6 - Production of Large Optimized Cells - This task still needs to be completed.

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